

All the UG & PG syllabus are the approved syllabus for the University
from academic session 2011-2012.

By Order
Vice Chancellor

SYLLABUS

West Bengal State University
Course structure for three year B.Sc. (Hons.) in
MICROBIOLOGY under 1+1+1 System

Part I (Full marks 200)
(Exam at the end of 1st year)

Paper-I (100 marks)

Group-A :	Biomolecules	50 marks
Group-B :	Biophysical chemistry	50 marks

Paper-II (100 marks)

Group-A:	General Microbiology	50 marks
Group-B:	Practical	50 marks

Part II (Full marks 200)
(Exam at the end of 2nd year)

Paper-III (100 marks)

Group-A:	Cellular and mollecular biology	50 marks
Group-B:	Metabolism and Bioenergetics	50 marks

Paper-IV (100 marks)

Group-A:	Environment and Food Microbiology	50 marks
Group-B:	Practical	50 marks

Part III (Full marks 400)
(Exam at the end of 3rd year)

Paper-V (100 marks)

Group-A:	Microbial Genetics	50 marks
Group-B:	Industrial Microbiology and Recombinant DNA Technology	50 marks

Paper-VI (100 marks)

Group-A:	Medical Microbiology and Virology	50 Marks
Group-B:	Immunology	50 Marks

Paper-VII (100 marks)

Practical

Paper-VIII (100 marks)

Practical

**GUIDELINES TO THE STUDENTS FOR B.Sc (HONS) EXAMINATION
IN MICROBIOLOGY ,2011 (NEW SYALLABUS)**

Part –I, Part-II, Part III

(For each group)

1. A Compulsory short answer type question of 10 marks comprising of 5 questions each carrying 2marks
2. Broad answer type questions to carry 10 marks and will be subdivided into sections carrying from 2 to a maximum of 5 marks. Students will have to answer 4 from a choice of

8 questions and the question will be spread across the syllabus .

Syllabus for B.Sc (Hons) Part-I Course in Microbiology effective from 2011-2012

P A R T -I (Full Marks -200)

Paper-I (100 marks)

Group-A : Biomolecules (50 Marks)

1. a) Bonding Features :(10)

Hybridization (s,p,n =1,2,3)of C, N, O; formation of sigma and pi bonds, bond distance, bond angles, shapes of molecules, strain due to valence shell electron pair repulsion, bond-stretching, angular distortion, steric effect, inductive and field effects; bond energy, bond polarity, resonance, resonance energy, steric inhibition , hyperconjugation.

b) Stereochemistry: (15)

General concept on: Symmetry Elements and Symmetry Operations -Axis of symmetry, plane of symmetry and centre of symmetry ; Projection formula (Fischer, Newmann & Haworth);

Concept of chirality; Chiral Centre, Helicity, Asymmetry & Dissymmetry, Isomerism: Optical Isomerism, Geometric Isomerism; Concept of Configuration and Configuration: DL, RS, Nomenclature of Carbohydrates, Amino Acids and other Organic Molecules. Conformation of Ethane, n-Butane, n-Propane, n-Butane gauche Interaction; Stereochemistry of cyclohexane: idea of axial and equatorial bonds (related to chair form conformation); Chair form of carbohydrates, Configurational Isomers:- anomers, epimer; Mutarotation & its Mechanism, Stereochemistry of Amino Acids, Anomeric effect.

2. Carbohydrates:(10)

Definition , classification and structural concept of Monosaccharides : Hexoses, Pentoses

(Ribose, Ribulose, Xylose). Dissaccharides : (Sucrose, Lactose ,Maltose), Amino Sugar (Glucosamine ,Muramic Acids), Inversion of cane sugar, Chemical reactions of monosaccharides (glucose, fructose) with HNO_3 , Br_2 -water, HIO_4 , phenylhydrazine; principle of chemical estimation of glucose ; anomeric effect ; Polysaccharides:chemical structure of starch (alpha-amylase, amylopectin), glycogen and cellulose .

3. Amino acids, Peptides and Proteins: (20)

a) Amino Acids and Peptides:(10)

Definition, classification, structure; physico-chemical properties of amino acids. , zwitterionic nature, pK values; Isoelectric point. Electrophoresis, Titration of amino acids Reaction with Ninhydrin, FDNB, Dansyl chloride, van Slykes reaction. Reactions of carboxyl and amino groups. . Peptides, peptide bond, biologically important peptides (glutathione). Ramachandran plot, Enzymatic digestion of peptide (trypsin, chymotrypsin, papain, aminopeptidase, carboxypeptidase)

b) Proteins:(15)

Structure of segment of polypeptide chain (primary, secondary, super-secondary, tertiary ,quaternary) Forces that stabilize structure of proteins; H-bonds, Hydrophobic interactions, electrostatic attraction, van der Waals interaction, Dipole dipole interactions, Solubility of proteins, Salting in and Salting out, Denaturation and renaturation ; Types of proteins : Fibrous and globular protein with some examples. Brief discussion of protein separation technique (Ion exchange, Gel filtration chromatography)

4. Lipids:(10)

Definition, nomenclature, classification-(simple, complex, derived lipids) structure and example- phospholipids, glycolipids, sphingolipids. Hydrolysis of fats and oils, saponification. Saponification number, Iodine number, Acetyl number, Volatile fatty acid number- definitions and related problems, Fatty acids: Saturated, Unsaturated : nomenclature and structure –delta and omega-system—Oleic, Linoleic, Linolenic and Arachidonic Acid; Essential fatty acids. General chemical reaction of fatty acids-esterification, hydrogenation

5. Nucleic acid:(15)

Purine and Pyrimidine- definition and structure, Nucleoside, Nucleotide: definition and structure DNA and RNA: Double helical structure, A-DNA, B-DNA and Z-DNA, (structure and differences), intercalating agents. Chemical property: Hydrolysis (acid, alkali)

enzymatic hydrolysis of nucleic acids, general structure and functions of different types of RNA (t-RNA, m-RNA, r-RNA). Viscosity, Buoyant density, Hyper chromic and Hypochromic effect, cot curve, denaturation and renaturation of DNA.

Suggested text books :

- 1.Finar, I.L
- 2.Organic chemistry- Part I and Part II –I.L.Finar
- 2.Biochemistry-A.Lehninger
- 3.Biochemistry-J.Voet and R.Voet
- 4.Biochemistry-L.Stryer

Group B: Biophysical chemistry (50 Marks)

1. Physico -Chemical properties of water :(5)

Non-covalent interactions, Ionic product of water:, pH definition. Acids, Bases and Buffers in biological system ; Arrhenius and Bronsted -Lowry, Lewis theories of acid and bases. Titrable and true acidity, Polyprotic acids, Ampholytes, Dissociation of polyprotic acids, Surface tension, viscosity : application to biomolecules.

2.Thermodynamics and its application to biological systems: (15)

Zeroth law, 1st and 2nd law of thermodynamics, application in biological systems. Enthalpy and Entropy, Concept of free energy, standard free energy change. Equilibrium constant. Transport across membrane- passive diffusion, facilitated diffusion and active transport; gradient of chemical potential as a driving force in transport, equilibria and transport across membranes; diffusion and osmosis, sedimentation by centrifugation (Density gradient and isopycnic), osmotic pressure, Donnan equilibrium, diffusion potential, membrane potential.

3.Spectrometry (10)

Concept of Electromagnetic radiation, UV, Visible,IR, Molecular orbital theory : Bonding and antibonding ; simple association of atomic orbital to form pi and sigma molecular orbital .HOMO AND LUMO; UV spectra : Electronic transition (σ - σ^* ,n- σ^* , π - π^* and n- π^*), concept of chromophore , Wit's chromophore theory, auxochrome, red shift, blue shift,

Lambert Beer law- derivation and deviation, Molar absorptivity,;Line diagram and working principle of spectrophotometer ,solvent effect, hyperchromic effect (typical example), Fluorescence,and Spectrofluometry., IR spectra : modes of molecular vibration, application of Hook's law ,force constant ,characteristic and diagnostic stretching frequency ,of O-H, N-H ,C-D, C=C, C=N, C=C, C=O functions ;factors of effecting stretching frequencies (H -bonding mass effect , electronic factors, bond multiplicity)[diagnostic bonding frequencies excluded]

4. Microscopy : (5)

General principles of optics in relation to microscopy; different components of light wave (UV ,IR ,Visible); principles and applications of compound microscope; Light microscope; Dark field microscope; Bright field microscope; Phase contrast microscope; Fluorescent Microscope; Electron Microscope (Principle only); Resolving power ;Numerical aperture; Chromatic aberration and spherical aberration.

5.Fundamentals of radioactivity :(10)

Law of radioactivity, Decay constant, half life, average life, properties of α , β , γ radiations, unit of radioactivity, radioactive carbon dating, Application of radioactivity isotopes (C^{14} , H^3 , P^{32}) in biological systems, preliminary concept in radioimmunoassay, principle of liquid scintillation counter and GM counter. Radiation absorption- Biological effectiveness- Linear energy transfer- radiation protection.

T E X T B O O K:

1.Tinoco, Sauer and Wang, Physical chemistry, principles and application in Biological sciences, Prentice Hall, 4th edition (2001).

ADDITIONAL REFERENCE TEXTS:

1. Atkins physical chemistry for the life sciences, W H Freeman (2005).
2. Cantor and Schimmel, Biophysical chemistry, (part1) Freeman Press.
3. Eisenberg and Crothers, Physical chemistry with application to the life sciences, Benjamin/ Cummings publication Co (1979).
- 4 P. Atkins and J Paula, physical chemistry for the life sciences (2006).
2. K.E van Holde, WC Johnson and P.S.Ho. Principles of physical biochemistry (1998).

Paper-II (100 marks)

Group A : General Microbiology (50 marks)

1. Notable contributions in the development of Microbiology :(3)

- i) Spontaneous generation (abiogenesis)
- ii) Biogenesis.
- iii) Germ theory of Disease.
- iv) Koch's postulates
- v) Scope of Microbiology.

2. Position of microorganisms in biological world (7):

Whittaker's Five Kingdom and Carl Woese three domain concept of living organisms (General characteristics of those groups); General features of Eubacteria and Archaeobacteria (major difference within eubacteria).

3. Stains and staining techniques :(10)

Definitions of auxochrome; chromophores; Acidic and Basic dyes; classification of stains; simple and differential staining: theories of staining, mordant and its function, Gram staining, acid fast staining, endospore staining, negative staining, capsule staining, flagella staining, mechanism of Gram staining.

4. Bacterial morphology and sub-cellular structures:(20)

Morphology of bacteria, slime layer, Mycelial morphology: Actinomycetes, capsule, cell wall and ribosome, cytoplasmic membrane (Fluid mosaic model of Singer-Nicholson), cytoplasmic inclusion bodies - (inorganic -organic); Exospores and cysts: types and structure; Endospore, Flagella,, Pilus, Fimbriae (structure, composition and function) plasmids and episomes, bacterial nucleoid.

5. Eukaryotic microbes (10):

General characteristics, vegetative and reproductive structure with example of the following groups of microorganism :

Algae : Cyanophyta, Chlorophyta, Bacillariophyta, Phaeophyta, Rhodophyta.

Fungi : Phycomycetes, Ascomycetes, Basidiomycetes, Deuteromycetes

Protozoa : *Giardia*, *Plasmodium* and *Entamoeba*.

6. Microbial Nutrition: (10)

Nutritional types (definition and example) - photoautotrophs, photoorganotrophs, chemolithotrophs (ammonia, sulphur, hydrogen, Carbon monoxide and iron oxidizing Bacteria); chemoorganotrophs, Effect of oxygen on growth- classification on the basis of oxygen requirement and tolerance.

7. Bacterial Growth :(10)

Growth phases- Generation time, kinetics of growth, Batch culture, Continuous culture, synchronous culture (definition and brief description) physical factors influencing growth - temperature- pH, osmotic pressure, salt concentration. Growth measurement technique.

8. Control of growth of microbes :(15)

Sterilisation, disinfection, antiseptic, sanitizer, germicide, antimicrobial agent (definition) application and examples; physical method of disinfection and sterilisation, dry heat, moist heat, filtration, radiation (mode of action, applications); chemical control -dye solutions, alcohol, acid, alkali, halogen, heavy metal, phenol and phenol derivatives ,formaldehyde, ethylene oxide, detergents (mode of action, applications). Assessment of chemical disinfectant, phenol coefficient -definition and method of determination. Chemotherapeutic agents -sulphonamides, antibiotics, (definition types), mechanism of action and antimicrobial spectrum of penicillin, streptomycin, tetracycline chloramphenicol nalidixic acid and metronidazole; drug resistance -phenomenon and mechanism.

Suggested Textbooks:

1. Stanier, RY., *et al*, General Microbiology, 5th ed Macmillan press.
2. Pelczar M., *et al* Microbiology, 5th ed,. 2000, Tata Mcgraw Hill.
3. Atlas RM, Principles of Microbiology, 2th ed, 1997 Tata Mcgraw Hill.
4. SalleAJ, Fundamental principles of Bacteriology, 7th ed, 1999 Tata Mcgraw Hill.
5. Prescott LM, Microbiology, 6th ed, 2005 Tata Mcgraw Hill.
6. Madigan MT, Martins JM & Parker, J , Brocks Biology of Microorganism – Prentice Hall International Inc.
7. H.G. Schlegel , General Microbiology – Cambridge Press
8. A.K.Banerjee & N.Banerjee , Fundamentals of Microbiology & Immunology, Central

Group B : Practical (50 marks)

:

1. Qualitative tests of Reducing and non reducing monosaccharides and disaccharides, polysaccharides, amino acids (identification of specific amino acids not required) proteins (Biuret method), cholesterol :(8)
2. Quantitative estimation of reducing sugar by 3,5 dinitrosalicylate method, DNA and RNA by UV spectroscopy and protein by Biuret method. :(8)
3. Estimation of amino acid by formol titration. (4)
4. Operation of light microscope; use of oil- immersion objective (4)
5. (a) Preparation of culture media :(10)
Complex media (Nutrient Broth, NA slant, NA stab, Lactose broth); chemically defined, synthetic media (Czapekdox broth / agar). YPD /select media which will be used for the experiments specified.
(b) Cultivation of microorganisms: on agar – slant /agar plate streak culture: Bacteria (*Bacillus subtilis* ,*Staphylococcus aureus* , *Escherichia coli*); Yeast (*Saccharomyces cerevisiae*) Moulds (*Penicillium notatum*, *Aspergillus niger*).& Pure culture: by streak plate / pour plate methods (18)
(c) Staining techniques for examination of microorganisms (20)
i) Bacteria -preparation of heat fixed smear and (a) simple staining and negative staining (*E. coli*, *Bacillus subtilis*, *Staphylococcus aureus*) (b) Gram staining- Gram positive (*B. Subtilis* ,*S. aureus* ,*M. lutea*) Gram negative (*E. coli*, *K. aerogenes*) (c) Endospore staining (*B. Subtilis*)[Dorner and Foulton method]
ii) Fungi-Lactophenol -cotton blue staining of Yeast (*Saccharomyces cerevisiae*): Molds (*Penicillium notatum*, *Aspergillus niger*).

[Figures given in the parenthesis above are the
Numbers of allotted classes for each topic]

West Bengal State University

PART II

Paper III Group A: Cellular and Molecular Biology (50 Marks)

Eukaryotic cell biology :(30)

Eukaryotic cell Membrane, Difference in membrane constituents between Eukaryotes and prokaryotes : target of antimicrobial drugs : Elementary idea of intracellular organelles, Comparison between Eukaryotic and prokaryotic flagella and cilia

Cell Biology of yeast : Yeast as model, Budding and fission, mating types and its determination (only elementary idea) mating type Mitosis and Meiosis, cell cycle switching, cdc mutants, Anti fungal drug, nistatin

DNA replication (15): semiconservative and semidiscontinuous mode of DNA replication , structure of replication fork ,enzymes of DNA replication (definition and function only), Rolling circle and θ mode of replication ,Inhibitors of replication (antibiotic), nalidixic acid.

Transcription in prokaryotes (15) :

Mechanism of transcription , mechanisms ,initiation , elongation, termination, promoter structure, subunits of bacterial RNA polymerase, functions and domains responsible for activity, mechanism of termination rho dependent and independent, lac and tryp operon, arabinose operon, brief idea of capping, polyadenylation and splicing.rifampicin , streptolydigin(antibiotic)

Mechanism of translation in prokaryotes : (15)

Description of ribosomal cycle including phenomena of initiation ,elongation ,termination ; description of factors involved in these process ; genetic code ; wobble hypothesis, role of amino acyl t-RNA synthetases, inhibitors of translation(antibiotic only) streptomycin, chloramphenicol, tetracyclin and puromycin.

Text Book:

Stryer .L. et.al. Biochemistry ,5th edition ,WH,Freeman ,2006

Voet. D, and Voet JM , Biochemistry , Willey , 1995 ;

Reference books : Alberts , B, et.al. Molecular Biology of the cell , Garland , 4th edition

Lodish , et. Molecular cell biology , WH Freeman; 2003

Group : B : Metabolism and Bioenergetics(50)

Enzyme : (25)

General properties , Trivial and IUB nomenclature and classification ; cofactors , definition and function with special reference to the representative point to the substances -a) co-enzyme (NAD⁺, NADP⁺, co-enzyme A , TPP, pyridoxal, phosphate , b) prosthetic , groups (FAD⁺, succinic dehydrogenase); c) Metal ions (Zn²⁺, Mg²⁺, Fe²⁺, Fe³⁺, Mn²⁺,) required for enzyme action, isoenzyme .

Enzyme Kinetics : Michaelis-Menton equation , enzyme inhibition Competitive , Regulatory enzymes (Allosteric Site CTP on aspartate trans carbamylase as example) feedback inhibition , reversible competitive , non competitive , substrate level inhibition irreversible inhibition , suicide inhibitors. Feedback inhibition (Cite Threonine to Isoleucine as example) Ribozyme (catalytic RNA) and Abzyme (use of Antibody as enzyme) -definition only.

Carbohydrate metabolism :(25)

Aerobic respiration -Glycolysis (EMP-pathway) with energy production: entry of galactose and fructose in EMP-path ; TCA cycle with energy production ; pentose phosphate pathway Electron Transport chain (in brief) and ATP generation sites : ATP and ADP cycle (Oxidation -reduction potential and electromotive force). Photophosphorylation , oxidative phosphorylation (chemiosmotic theory); Anaerobic respiration Utilizing NO₂ sulfur SO₄ , CO₂ as electron acceptors; Stickland reaction Entner-Doudoroff pathway Fermentation-Glucose metabolism in anaerobic condition general concept only . Bacterial photosynthesis (cyanobacteria and green sulphur bacteria)

Amino acid metabolism (10):

Transamination , deamination transmethylation and decarboxylation. Glucogenic and ketogenic amino acids , Outline of Urea cycle ; Microbial metabolism glycine, phenylalanine

Lipid metabolism :(5)

Detailed account for oxidation of even and odd carbon numbered , saturated and unsaturated fatty acids, metabolism of triglycerides and phospholipids, brief idea of ketone bodies.

PAPER -IV

Group A, Environmental and food Microbiology : (50)

Air Microbiology ;(5)

Different type of Microorganisms in the air (name and disease) ,aerosole ,sampling techniques ,air borne pathogens ,techniques of room sterilization .

Microbiology of water :(10)

Microbiological analysis of water (total count ,indicative organism),BOD, COD, -determination and implication ,Coliform test-detection of feacal and nonfeacal coliform); IMVIC test ,determination of MPN microbiological treatment of sewage and industrial waste water ,Anearobic treatment (safety tank).

Soil microbiology :(25)

Physical and chemical charecteristics of various soil types -different microbial groups in soil ,method of study,Rhizosphere ,Pyllosphere ,brief account of microbial interactions (symbiosis,neutralism,commensialism,synergism competition,ammesialism,parasitism,and predation):Biological nitrogen fixation-symbiotic;and asymbiotic Root -nodule formation in legumes; Compost and humans biofertilizers,biogeochemical cycles Carbon ,Nitrogen Phosphorus, and sulphur cycles, role of microorganism in the process of methane production.

Food Microbiology (15):

Milk as a growth of medium of bacteria ,Normal microflora in milk ,undesirable microbes in milk and normal microflora of meat ,poultry of egg ,fruits and vegetable ,canned food and stored grains, phosphatase tests of pasteurized milk .

Preservation of food : preliminary idea of physical, chemical, biological preservatives, radiation, High temperature (Boiling, pasteurization,Appetization ,)low temperature (Freezing): Dehydration.Osmotic pressure .

Microbiologically fermented food : curd .cheese Idli, yogurt, Acidophilic,Milk microorganisms as food -SCP : food borne diseases -name and agent.

Text book : Salle AJ. Soil Microbiology ,7th edition ,Tata Mcgraw Hill publishing Co.

Reference : Subba Rao , NS.Soil Microbiology 4th edition ,Oxford and IBH Publishing Co.

Dube R C and Maheswari,DK Text book of Microbiology ,S. Chand and Co.

Group B Practical (50) Marks :

1) Isolation of pure culture from natural sources (36)

(a) Bacteria from soil-by serial dilution and pour plate / spread plate method .(b) isolation of amylase and phosphatase producing bacteria (qualitative only)

(c) Yeast from rotten banana or apple-by the method same as (a),

(d) molds from infected citrus fruits-by streak-plate method.

(e) Microbes from air-by agar-plate exposure method.

2) Microbiological examination of water: (Drinking water,supply water,pond water)

a) presumptive test.

b) confirmatory test.

c) completed test for coliform.

IMVIC reactions.

3) Microbiological examination of milk : By Methylene-blue dye reduction test :

4) Microbiological assay of antibiotics :i) Antibiotic sensitivity test by paper disc and by cup-plate method.

ii) Determination of minimal inhibitory concentration(MIC) by serial dilution method for assaying commonly used antibiotics (using appropriate test bacterial).

5) Micrometry (5)

Microscopic measurements of Yeast

6) Enumeration of Microbes : Yeast by haemocytometer (5)

7) Bacterial growth curve by nephelometric method (*E. coli*) (4)

PART III
Paper v
Group A: (50 marks)
Genetics and Biometry

1. Principles of elementary genetics: (15)

Mendelian genetics-

Genotype, Phenotype, Multiple Allele, Monohybrid, Dihybrid cross, Linkage Codominance, Phenotypic change due to environment, autosomal & sex linked inheritance .

Experimental evidence for DNA as genetic material (Experiments of Griffith, Avery and MacLeod; Hershey and Chase); Experimental evidence for RNA as genetic material (TMV),

Structure of prokaryotic gene; genomic organization in prokaryotes (nucleoid, DNA supercoiling, topoisomerases), Plasmids (types, copy number, compatibility, plasmid curing). Episomes. Structure of eukaryotic genes, chromosome and genome organisation, repetitive DNA. Extrachromosomal inheritance (mitochondria and plastids).

2. Genetic exchange and recombination : (15)

Transformation, Conjugation:F+, F-,Hfr and F Prime and F double prime bacteria, conjugation procedure and mapping.Development of competence using B.subtilis as model organisms, procedure of natural transformation, artificial transformation, chromosome mapping, genetic mapping of transformants.

Transduction-generalized (P1) and specialized (lambda-phage) and mapping.

Homologous recombination (Holiday structure: RecBCD system); gene conversion ; site specific recombination (lambda).

Transposable elements : Bacterial Transposons.(Types of transposons, TN family, mechanism of transposition and application.

3. Mutation and Repair (10)

Spontaneous (Spontaneous mutation Luria-Delbruck's Fluctuation Test) an induced mutations, Mutagenic agents-Physical, Chemical and Biological (Phage-mu). Genetic Techniques to detect mutations in bacteria and fungi (isolation and characterization of nutritional auxotrophic mutation); Different forms of mutations and how they arise (tautomeric shift, base analog, alkylating agent, apurinic lesions, UV radiation and thymine dimers, replicational error); Ames test.

Repair : Reversal of UV damage in prokaryotes : photoreactivation, base excision and nucleotide excision repair , post replicational repair, mismatch repair, SOS repair, error prone repair.

4. Biometry (10)

Types of biological data, population and samples. Descriptions of samples and populations : frequency distributions descriptive statistics (measures of central tendency and measures of dispersion, boxplot) , Distribution theory: Normal distribution and sampling distribution.

Statistical Inference: statistical estimation, standard error of the mean.Confidence interval and hypothesis testing of the population mean, t-test, brief discussions on the comparison of two independent population means. Chi square test and its applications.

Books:

1 Molecular Biology of the Gene(5th edition) : By James D watson etal

- 2 Concept of Genetics (6th Edition) : By Klug Cummings
3. Genetics : Principles of Analysis (4th edition) : By Hartl & Jones
 4. Genetics : Analysis and Principles : By Robert J Brooker
 5. Statistics: Goon gupta Dasgupta

Group B : Industrial Microbiology and Recombinant DNA Technology (50 marks)

Industrial microbiology

Microbial culture selection by screening method with reference to the Antibiotic and Enzyme production. Strain improvement, equipment and instrumentation (fermenters-General description of different types-stirred Tank, Bubble column, Air Lift, Packed-bed Bioreactor)

Fermentation-static, submerged, agitated, solid phase , batch, fed-batch, continuous. Use of immobilized cells and enzymes (Cal-alginate beads , polyacrylamide, micro-film)-definition and general characteristics, industrial production of Ethyl Alcohol, Acetic Acid, Pencillin, Vitamin B12, Lysine, amylase(inoculum building, scale up). Fermentation - separation assay and purification of products-general discussion) Concept of Primary and Secondary metabolites in Microorganisms.

General method of preservation of industrially important culture strains : (2)

Recombinant DNA Technology:

Isolation and purification of nucleic acid. Purification and separation of proteins by chromatography(gel filtration, ion exchange, affinity). Separation of Amono acids and lipids by TLC.

Cloning of gene, restriction and modification enzymes. Cloning vectors (PBR2, puc18/19, YAC, vector, Ti plasmid as transforming vector) Shuttle vector and cosmid vector.

Strategies of blunt and staggered end cloning.

Basic differences between cloning and expression vector. Some techniques used in RDT (RFLP, RAPD, Finger printing, DNA sequencing(Sanger, Maxum-Gilbert)

Construction of Genomic and c DNA library

Enzymes used in RDT (DNA polymerase, DNA Ligase, alkaline phosphatase, polynucleotide kinase, terminal transferase)

Production of human insulin by RDT.

Paper VI

Group : A : Virology and Medical Microbiology (50 marks)

Virology : (22)

General characteristics of viruses:Difference between bacteria and viruses, Components of viruses, symmetry and host range and specificity.

Classification of viruses based on the capsid symmetry and nucleic acid content(Baltimore Classification), Types of viruses

a. Bacteriophage(T4 lambda, Lytic and lysogenic life cycle of bacteriophage lambda, one step growth curve, plaque assay).

b. Plant virus (General features of TMV)

c. Animal virus (HIV and its role in AIDS)

d. Oncogenic virus SV 40

Virus like agents: Virioids; prions; phage mechanism(s) that determines lytic and lysogenic life cycle, Antiviral agents, interferon, Azt, acyclovir

Medical Microbiology

Normal Microbial Flora of human body

Thoracic, abdominal, Urogenital & Skin.

Mechanism of Bacterial Pathogenicity: (20)

Entry colonisation, growth, mechanism of damage of host cell.

Production of endo- and exotoxins - definition and general properties.

(a) Neurotoxin: botulinum toxin, tetanus toxin:

(b) Enterotoxin: cholera toxin, salmonella toxin.

(c) Diphtheria toxin.

(d) Toxoid

Common Microbial Diseases : (15)

Names of pathogens, symptoms, preventive measures and vector control where applicable.

i) Bacterial - Tuberculosis, Leprosy, Tetanus, cholera, Anthrax, Typhoid

ii) Viral - Influenza, polio

iii) Fungal - candidiasis.

iv) Protozoan - Malaria, Amoebiasis, leishmaniasis.

Group B: Immunology (50 marks)

Overview of the Immune system. (2)

1. Cells and organs - Immune system. Haematopoietic stem cells, (stromal cells)?, haematopoietic growth factors, Lymphoid organs (Primary and secondary) and cells, Mononuclear cells, Granulocytic cells, Mast cells, Dendritic cells - characteristics and functions. (10)

2. Types of Immunity : Humoral and Cell-mediated immunity - mechanism of immune response - antigen processing and presentation, types and structures of Major histocompatibility complex molecules (MHC) and their role in antigen presentation, clonal selection of lymphocytes, definition of cytokine, generation and humoral and cell mediated response by cellular interactions (general concept only). (14)

3. Antigens : chemical nature, antigenicity, immunogenicity, hapten, epitopes, mitogens (definition, properties, examples); Adjuvant (definition, examples, functions). (6)

4. Immunoglobulins : Isotypes - definition, basic and fine structures, general characteristics and functions. Monoclonal and polyclonal antibody (definition and characteristics). (8)

5. Antigen-Antibody interactions : Precipitation reactions - Radial immunodiffusion, double immunodiffusion, immunoelectrophoresis; Agglutination reactions - Hemagglutination, passive agglutination, bacterial agglutination, agglutination inhibition. (5)

6. Complement : The complement components, function, complement activation - Classical, (ii) Alternate and (iii) lectin pathways (characteristics & functions). (6)

7. Hypersensitivity: definition, types, examples (2)

8. Vaccines : Active and passive immunization (definition, characteristics, examples and functions). Attenuated and inactivated viral or bacterial vaccines (definitions characteristics, functions, examples). Autoimmune disease.

Paper VII(100 marks)

1. Separation of Amino Acids and monosaccharides by paper chromatography and by TLC.

2. Standard curve of:

- a) reducing sugars
- b) paranitrophenol
- c) protein (Bradford and Lowry)
- d) Ammonia (Nessler method)

3 (a) Determination of K_m , V_{max} and pH optima of α - amylase. Alkaline phosphatase and urease.

- (b) Progress curve of alpha -amylase. Alkaline phosphatase and urease.
- (c) Inhibitory study of alkaline phosphatase (by inorganic phosphate)

Industrial Visit (10)

Paper VIII (100 marks)

Practical

1. Antigen-Antibody reaction-

- a.) Agglutination (blood typing)
- b.) Ouchterlony's agar diffusion method.
- c.) Single radial immunodiffusion (Mancini's method).
- d.) Immunoelectrophoresis

2. Isolation of plasmid-DNA from E. coli by using a standard method: Gel-electrophoresis (Agarose-gel), quantification and purity of DNA.

3. Transformation of E. coli by plasmid DNA (CaCl_2 method)

4. Conjugation experiments

5. Plaque assay of bacteriophage.